REMARKS

The Present Invention and Pending Claims

Claims 1-5, 7, 9-16, and 18-26 are currently pending and directed to a flexible metal-clad laminate (claims 1-5, 7, 19-25), a method of producing the laminate (claims 9-16), and a flexible printing wiring board (claims 18 and 26). The flexible metal-clad laminate is resistant to curling, and also exhibits improved heat resistance, dimensional stability, adhesion, chemical resistance, and alkali resistance. The invention is predicated, at least in part, on the discovery that a highly cross-linked structure of the heat-resistant resin of the flexible metal-clad laminate achieves these beneficial characteristics. The extent of cross-linking is indicated by an N-methyl-2-pyrrolidone-insoluble content of at least 1%.

The importance of having an N-methyl-2-pyrrolidone-insoluble content of at least 1% is demonstrated by the data in Tables 1-3 of the specification. Comparative Examples 1 and 4 have an N-methyl-2-pyrrolidone-insoluble content of less than 1%, and the metal-clad laminates show curling (i.e., a radius of curvature of 15 cm or less) and a thermal gradient dimensional change of more than 0.1% (see Table 2 of the specification). In comparison, Example 1, which has an N-methyl-2-pyrrolidone-insoluble content of 2%, shows *no* curling, and shows a thermal gradient dimensional change of *not* more than 0.1%.

Additionally, when compared to the metal laminates of Comparative Examples 1 and 4 (which have an N-methyl-2-pyrrolidone-insoluble content of less than 1%), the metal-clad laminate of Example 1 (which has an N-methyl-2-pyrrolidone-insoluble content of 2%) shows superior adhesion, initiation tear strength, tensile strength, elongation, elastic modulus, and elastic modulus retentivity (see, Table 3 of the specification), even though the difference in N-methyl-2-pyrrolidone-insoluble content between the metal laminates of Comparative Examples 1 and 4 and Example 1 is quite small.

Thus, the N-methyl-2-pyrrolidone-insoluble content of at least 1%, as recited in claims 1 and 19 (and claims dependent thereon), has a significant influence on the properties of the metal-clad laminate.

The Amendment to the Specification

The specification has been amended to correct a typographical error. Accordingly, no new matter has been added by way of this amendment.

The Amendments to the Claims

Claim 1 been amended to point out more particularly and claim more distinctly the present invention. Specifically, claim 1 has been amended to correct typographical errors, to recite additional characteristics of the metal-clad laminate, and to incorporate the features of claims 6 and 8. Accordingly, claims 6 and 8 have been canceled to prevent redundancy. The additional amendments to claim 1 are supported by the specification at, for example, page 32, lines 10-19. Claim 17 has been canceled. Claims 19-26 are new and supported by the specification as a whole, and specifically at, for example, page 15, line 23, through page 16, line 14). Claims 19-26 correspond to claims 1-7 and 18, but are directed to a condensation polymer comprising the unit represented by formula (2) instead of formula (1) (as in claims 1-7 and 18). Accordingly, no new matter has been added by way of the amendments and the addition of the new claims.

The Office Action

The Office has issued a restriction requirement between two groups of claims: Group I (claims 1-8, 17, and 18) and Group II (claims 9-16). The Office has rejected claims 1-5, 7, 8, 17, and 18 under 35 U.S.C. § 102(b) as allegedly anticipated by Numata et al. (US 4,792,476). The Examiner also has rejected claims 1-5, 7, 8, 17, and 18 under 35 U.S.C. § 102(b) as allegedly anticipated by Ohmura et al. (US 4,377,652). Claims 1-5, 7, 8, 17, and 18 have been rejected under 35 U.S.C. § 103(a) as allegedly obvious over Watanabe et al. (US 3,936,575) in view of Frost (US 3,984,375). Claim 6 has been rejected under 35 U.S.C. § 103(a) as allegedly obvious in view of Ohmura et al., Numata et al., or Watanabe et al., in combination with Frost and Akahoshi (US 4,970,107). Reconsideration of these rejections is hereby requested.

Election

Applicants confirm the election, with traverse, of the claims of Group I (claims 1-8, 17, and 18). Newly added claims 19-26 correspond to the Group I claims directed to a flexible metal-clad laminate.

Discussion of the Restriction Requirement

There are two criteria for a proper requirement for restriction between patentably distinct inventions: (i) the inventions must be independent or distinct as claimed, and (ii) there must be a serious burden on the Examiner if restriction is not required. M.P.E.P. § 803. Consequently, as set forth in M.P.E.P. § 803: "If the search and examination of an entire

application can be made without serious burden, the examiner must examine it on the merits, even though it includes claims to distinct or independent inventions."

In the case at hand, the Office has failed to meet the criteria for a proper restriction requirement by not even so much as asserting that there would be a serious burden on the Office if the election of inventions were not required. The nature of the claims is such that references cited against the claims of Group I would almost certainly be cited by the Office against the claims of Group II.

Under the circumstances, there would be no serious burden on the Office to search and examine the claims of both Groups I and II at the same time. Accordingly, the restriction requirement is improper. Applicants therefore respectfully request that the restriction requirement be withdrawn and that all the pending claims be examined together.

Discussion of the Rejection under Section 102(b)

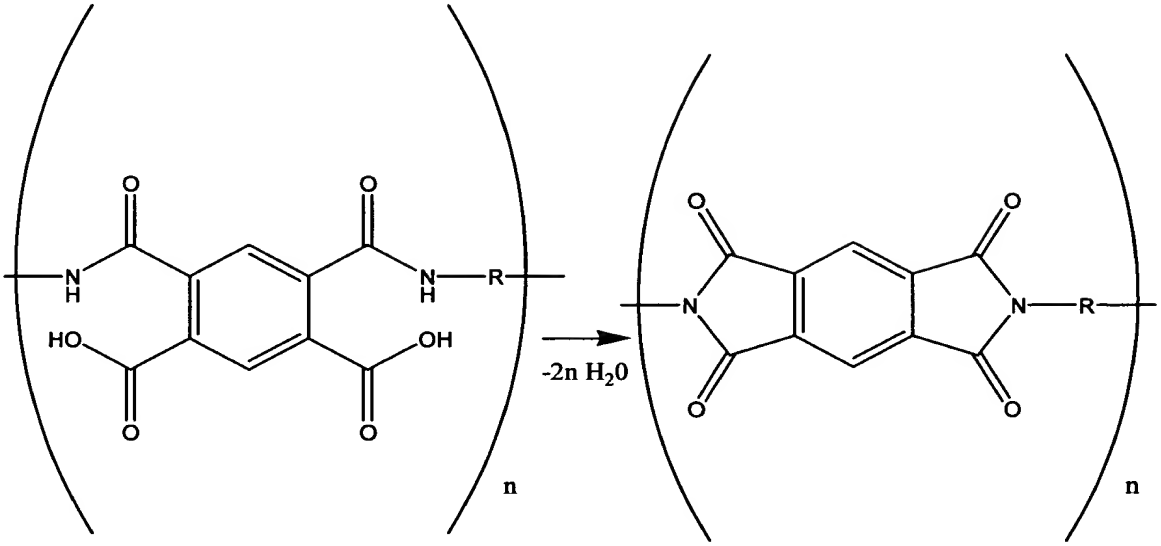
The Office contends that claims 1-5, 7, 8, 17, and 18 are anticipated by the Numata and Ohmura references. These rejections are traversed for the following reasons.

A. The Numata Reference

The Office contends that the Numata reference directly or inherently discloses all of the elements of the claimed invention. The Office contends that the copolymer of a polyamide acid and a polyimide of formula (III) would contain repeating units that read on formula (1) of claim 8 (currently amended claim 1) of the subject application.

However, the condensation polymer comprising the unit of formula (1) recited in claim 1 of the subject application is a polyamide-imide, which is not the same as a copolymer of a polyamide acid and a polyimide of formula (III) as disclosed in the Numata reference. A polyamide acid denotes a polyimide precursor that can undergo dehydrative cyclization to form a polyimide upon heating (see Diagram A).

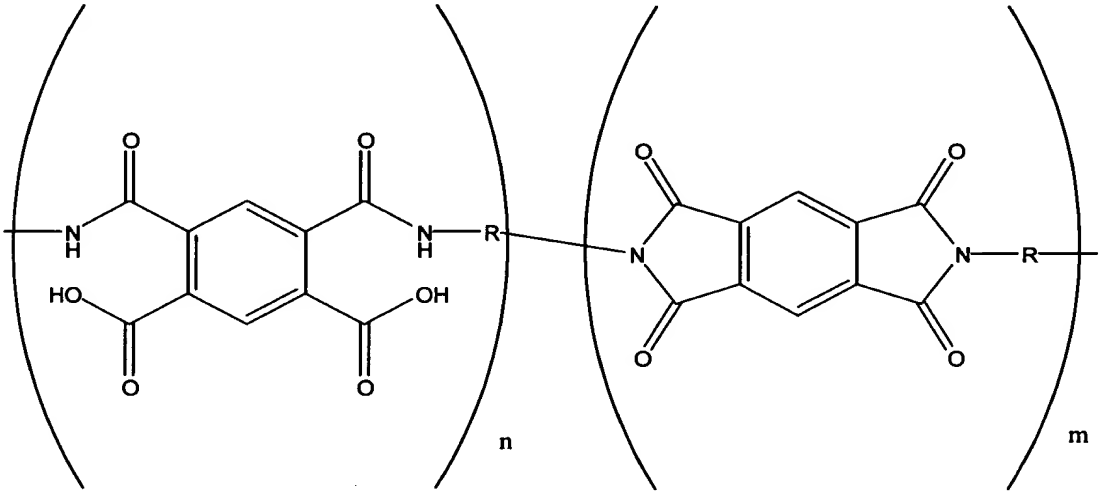
Diagram A:



polyamide acid polyimide

Therefore, the "copolymer of a polyamide acid and polyimide," which is disclosed in the Numata reference, has a structure (see, e.g., Diagram B), which is completely different from formula (1) recited in claim 1 of the subject application.

Diagram B:

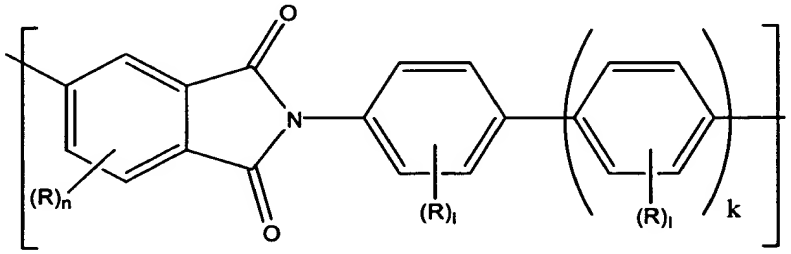


amide acid imide

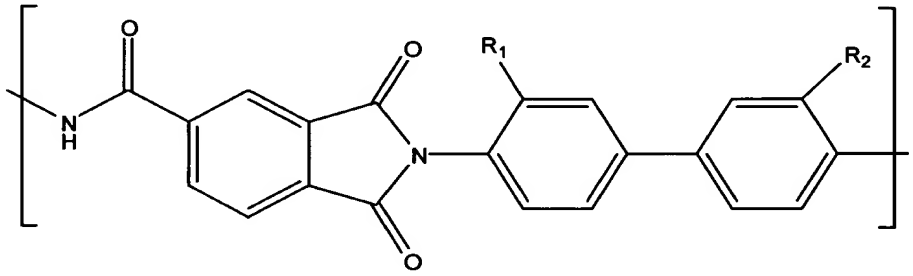
Similarly, the low thermal expansion polyimide disclosed by the Numata reference (i.e., the polyimide represented by formula (III) of the Numata reference) is not identical to

the heat resistant resin recited in claim 1. In particular, formula (III) of the Numata reference does not contain the amide-linking group of formula (1) of claim 1 of the subject application (see Diagram C).

Diagram C:



Formula (III) of the Numata Reference



Formula (1) of the Subject Application

Additionally, the pending claims require a crosslinked condensation polymer having an N-methyl-2-pyrrolidone-insoluble content of at least 1%. The present invention successfully solves the problem of curling due to thermal stress caused by the difference in coefficients of thermal expansion by using a crosslinked polymer which has an N-methyl-2-pyrrolidone-insoluble content of at least 1%. The Numata reference does not disclose or suggest this essential element of the pending claims, but rather intends to solve the curling problem by using a low thermal expansion resin material having an extremely small thermal expansion coefficient (see column 2, lines 18-23, of the Numata reference). The polyimide of the Numata reference has an almost linear structure (see column 6, lines 50-55, of the Numata reference), which indicates that the polymer is not crosslinked as required by the pending claims.

Moreover, claim 1 (as well as the claims dependent thereon) requires that the average surface roughness, Ra, of the surface of the heat-resistant resin film layer, which is in contact with the metal foil, is not more than 0.4 μm. This feature is not taught or suggested by the Numata reference.

Accordingly, the flexible metal-clad laminate of claim 1 (and claims dependent thereon) of the subject application cannot be considered to be anticipated by the Numata reference. Moreover, newly added claims 19-26 are not anticipated by the Numata reference because the Numata reference does not disclose a unit containing a naphthalene moiety as in formula (2) of claims 19-26.

For the above reasons, the Numata reference does not teach or suggest every element of the pending claims, and the anticipation rejection based on the Numata reference should be withdrawn.

B. The Ohmura Reference

The Office contends that the Ohmura reference teaches an aromatic polyamide-imide resin for use in insulative substrates, electrical circuit boards, and electrical elements. The polymer may comprise repeating units of formula (1) of the Ohmura reference, which, according to the Office, has the same structure as the formula (1) recited in claim 1. The Office contends that the metal-clad laminate of Ohmura has the same properties as the metal-clad laminate of the present invention, because the structure of the polymers allegedly is the same.

However, the Ohmura reference does not employ crosslinking, which is essential to achieve the beneficial properties of the present invention. For example, in Example 1 and Comparative Example 1 of the Ohmura reference, laminates are produced by impregnating a base material with a solution of N-methyl-2-pyrrolidone and N,N-dimethylacetamide in a polyimide resin and drying the materials at 100 °C for 3 hours and then at 150 °C for 2 hours, followed by press-molding the layered films at 200 °C for 30 minutes. Thus, the heating temperature in these examples is at a maximum of 200 °C and the heating times are relatively short. In contrast, the present invention discloses higher heating temperatures (e.g., about 250 °C to about 450 °C) for longer heating times (e.g., about 10 to 20 hours) (see specification page 27, lines 9-16, of the subject application).

Examples 1, 2, and 3 and Comparative Example 1 of the specification of the subject application show the effects resulting from this difference in the heating temperatures. Comparative Example 1, which was heated at 100 °C for 5 minutes and dried under reduced pressure at 200 °C for 20 hours, has an insoluble content of less than 1%, and does not meet the requirements of the pending claims. The laminate of Example 1, which was prepared by heat-treatment at 200 °C for 20 hours followed by heat-treatment at 260 °C for 3 hours under a nitrogen atmosphere, has an insoluble content of 2%, which meets the requirement of the pending claims. The laminate of Example 2, which was prepared by heat-treatment at 200 °C

for 20 hours followed by heat-treatment at 280 °C for 3 hours under a nitrogen atmosphere, has an insoluble content of 10%. Furthermore, the laminate of Example 3, which was prepared by heat-treatment at 200 °C for 20 hours followed by heat-treatment at 300 °C for 3 hours under a nitrogen atmosphere, has an insoluble content of 76%.

The results of these experiments reveal that the proper heating conditions are essential for achieving the requisite high N-methyl-2-pyrrolidone-insoluble content. Heating at high temperatures and for long periods of time form a crosslinking structure in the resin, which increases the insoluble content of the resin. In contrast, in the Examples of the Ohmura reference, heat-treatment is carried out at a lower temperature and for a shorter period of time, even as compared with the heat-treatment conditions used in Comparative Example 1 of the subject application.

Moreover, claim 1 (as well as the claims dependent thereon) requires that the average surface roughness, Ra, of the surface of the heat-resistant resin film layer which is in contact with the metal foil, is not more than 0.4 μm. This feature is not taught or suggested by the Ohmura reference.

Accordingly, the flexible metal-clad laminate of claim 1 (and claims dependent thereon) of the subject application cannot be considered to be anticipated by the Ohmura reference. Moreover, newly added claims 19-26 are not anticipated by the Ohmura reference because the Ohmura reference does not disclose a unit containing a naphthalene moiety as in formula (2) of claims 19-26.

For the above reasons, the anticipation rejection is improper, and the anticipation rejection based on the Ohmura reference should be withdrawn.

Discussion of the Rejections under Section 103(a)

The obviousness rejections are traversed for the following reasons.

A. Watanabe and Frost References

The Office contends that claims 1-5, 7, 8, 17, and 18 are obvious over the combination of the Watanabe and Frost references. The Office contends that the Watanabe reference does not teach a polyamide-imide that reads on the heat resistant resin of the present invention, but that the Frost reference teaches polyamide-imide resins consisting of repeating units of formula (1) and formula (2) of the pending claims.

The Frost reference does not teach or suggest the importance of crosslinking the polymer or having an N-methyl-2-pyrrolidone-insoluble content of at least 1% as recited in claims 1 and 19 (and claims dependent thereon). As discussed above, if the insoluble content

is at least about 1%, there is no curling of the metal-clad laminate, the thermal gradient dimensional change is less than 0.1%, and the properties of the metal-clad laminate are superior when compared to laminates having an insoluble content of less that 1%. For these reasons, having an N-methyl-2-pyrrolidone-insoluble content of at least 1% makes a significant difference in the properties of the metal-clad laminate.

The Frost reference merely teaches that the resin disclosed in the Frost reference possesses thermal stability, toughness, and good flexibility, but fails to address the problems of curling and thermal gradient dimensional change. Moreover, the Watanabe and Frost references do not teach or suggest how to solve these problems (e.g., by crosslinking the resin and requiring an insoluble content of at least 1%).

Therefore, the combination of the Watanabe and Frost references does not teach or suggest a metal-clad laminate having the features recited in claims 1 and 19 (and claims dependent thereon), or the superior effects achieved by the laminates having such features (namely, less curling and thermal gradient dimensional change). For these reasons, the Watanabe and Frost references cannot be considered to render the subject matter of the pending claims obvious, and the obviousness rejection should be withdrawn as to the referenced claims and is inapplicable to the newly added claims.

B. The Ohmura, Numata, Watanabe, Frost, and Akahoshi References

The Examiner concedes that the Ohmura, Numata, Watanabe, and Frost references do not teach that the surface of the heat resistant resin that contacts the metal layer should have a surface roughness of 0.4 μm, but contends that one of ordinary skill in the art would have been motivated to arrive at the invention by combining the teachings of the Akahoshi reference with the aforementioned references. The Akahoshi reference teaches a certain surface roughness for improving adhesion in a copper layer for a printed circuit board.

As described above, none of the above references, including the Akahoshi reference, discloses the importance of having a crosslinked condensation polymer and having an N-methyl-2-pyrrolidone-insoluble content of at least 1%, both of which features are required by claims 1 and 19 (and claims dependent thereon). Therefore, even if one were motivated to combine the teachings of the Akahoshi reference with the above references, one still would not arrive at the present invention as defined by the pending claims.

Therefore, while the obviousness rejection of claim 6 is moot in view of the cancellation of that claim, this obviousness rejection is not applicable to any of pending claims, including the newly added claims.

Conclusion

The application is considered to be in good and proper form for allowance, and the Examiner is respectfully requested to pass this application to issue. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

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